

**ANNEX
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
AND
THE BOEING COMPANY
UNDER SPACE ACT UMBRELLA AGREEMENT NO. 35290
(ANNEX NUMBER ONE)**

ARTICLE 1. PURPOSE

This Annex shall be for the purpose of collaborating on research to develop training methods to improve and evaluation methods to measure the monitoring skills of airline pilots as they manage and monitor the flight path of highly automated airliners. Inadequate monitoring has been implicated in the majority of airline incidents and accident, and thus improving monitoring is an important route to improving safety across the industry.

This Annex will focus on the following topics:

- 1) developing a prototype training module designed to improve the monitoring skills of airline pilots drawing on the sensemaking model of monitoring;
- 2) developing diagnostic measures/methods for assessing pilot skill and the effectiveness of a training intervention, particularly for monitoring and more specifically monitoring of the flight path. This includes both web-based and simulator-based evaluation;
- 3) designing and executing empirical assessment of pilot monitoring skills and the effectiveness of a training program.

Under this collaboration, NASA seeks to design, develop, and share web-delivered training for pilot monitoring based on the sensemaking approach and associated assessment. Boeing seeks to facilitate this collaboration by implementing the simulation sessions using Boeing engineering Cab (from here on referred to as "simulator(s)") to assess the training, to provide simulator runs of these evaluation sessions, and to explore applicability of these training and evaluation methods. NASA and Boeing intend to collaborate on implementation and execution of the simulator sessions, and on access to and recruiting of pilots participating in the training and evaluation.

The result of the research will include an interactive online learning module that any operator of modern aircraft could access and adapt for their operations. The web tool developed under this agreement will be owned by NASA and made publicly available. While NASA anticipates that the prototype training module will be directly useful, its main contribution may be as a base that airlines tailor to their specific fleets and needs. To this aim, NASA will provide not only the resulting web-based training module, but a description of the instructional design strategies and methods used to address the needs of the target learning audience.

The training module(s) developed and the design of the associated assessment plan are prototypes intended to assess the proof of concept for training cognitive skills such as monitoring but are not intended to serve as an airline's training materials. The intent is to release the training



module to the public, and both Parties agree that the training module does not fall under Article 5(A) and will not be subject to the one-year period of data protection.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the Space Act, Other Transactions Authority (OTA), 51 U.S.C. § 20113(e).

ARTICLE 2. RESPONSIBILITIES

A. NASA ARC will use reasonable efforts to:

1. Lead development of the web-delivered training prototype for pilot monitoring with associated evaluation measures.
2. Lead design of the simulator evaluation scenarios used to evaluate the learning modules in a simulator setting. Support the implementation of the simulator scenarios, with respect to design refinements and the mapping between the design specifications for scenarios and the implemented scenario set. Help address prioritization or tradeoffs which may develop in the implementation process.
3. Participate in the identification, recruitment, and scheduling of airline participants. Involvement of and feedback from airlines will be welcome.
4. Lead the design and execution of the web-based training and web-based evaluation. Lead the design of the simulator-based evaluation.
5. Participate in the execution of the simulator-phases of evaluation.
6. Lead the scoring, analysis, and presentation of data.

B. Partner will use reasonable efforts to:

1. Support development of the training prototype and associated evaluation, for example, by providing access to simulators or desk top trainers to ensure fidelity of the developed materials. No Boeing proprietary materials will be included in the web-module that might restrict its use.
2. Support design of the simulator evaluation scenarios used to evaluate the learning modules in a simulator setting. Lead the implementation of evaluation scenarios for a suitable, identified simulator type, for example, by provision of simulator operator and evaluation director.
3. Lead the identification, recruitment, and scheduling of airline pilot participants for the simulator evaluation. Boeing will reach out to airlines and pilot groups to recruit pilot participants.
4. Provide mutually scheduled simulator-time in the identified Boeing simulator(s) for conducting simulator-based evaluation.
5. Participate in execution of the simulator-phases of evaluation and provide time-synced video and simulator data streams from participants. The simulator-based evaluation study will be reviewed and approved by the Boeing Human Subjects Review Board (HSRB) as this will be done on a Boeing site. Documents will be collaboratively drafted. NASA will assess whether the prior web-based study will be bundled together with the simulator-based study, into one approval process, or separately approved through the NASA IRB.
6. Support data management and analysis.



7. For use of the training module after expiration of this agreement, enter into a Software Usage Agreement or agree with other terms imposed by NASA for use of the software by the public.

ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

Milestone	Estimated Completion Date
Agreed schedule for use of Boeing simulator resources (Boeing)	6 months from start
Report on prototype web training module and web evaluation (NASA)	9 months from start
Final report on revised web training module and simulator evaluation (NASA)	24 months from start

ARTICLE 4. FINANCIAL OBLIGATIONS

There will be no transfer of funds between the Parties under this Agreement and each Party will fund its own participation. All activities under or pursuant to this Agreement are subject to the availability of funds, and no provision of this Agreement shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, (31 U.S.C. § 1341).

ARTICLE 5. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

- A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of one year.
- B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.
1. Background Data: The Disclosing Party's Background Data, if any, will be identified in a separate technical document.
 2. Third Party Proprietary Data: The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate technical document.
 3. Controlled Government Data: The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.
 4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement: None

ARTICLE 6. TERM OF ANNEX



This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or two years from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

ARTICLE 7. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 8. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

Management Points of Contact

NASA Ames Research Center

Nahri Ahn
Agreement Manager
Moffett Field, CA 94035
Phone: 650-604-1179
nahri.i.ahn@nasa.gov

The Boeing Company

Balaguruna Chidambaram
Autonomy and Airspace Efficiency
Mission Systems and Autonomy
Boeing Research and Technology
Phone: 714-625-7563
Balaguruna.chidambaram@boeing.com

Technical Points of Contact

NASA Ames Research Center

Dorrit Billman
Research AST, Human/Machine Systems
Moffett Field, CA 94035
Phone: 650.604.5071
dorrit.billman@nasa.gov

The Boeing Company

John Dwyer
Technical Fellow
Autonomy and Airspace Efficiency
Mission Systems and Autonomy
Boeing Research and Technology
Huntington Beach, CA 92647-2048
Phone: (714) 342-2592
john.p.dwyer@boeing.com

ARTICLE 9. MODIFICATIONS

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

ARTICLE 10. SIGNATORY AUTHORITY



The signatories to this Annex covenant and warrant that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

**NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
AMES RESEARCH CENTER**

BY: _____
Dr. Huy K. Tran
Director of Aeronautics

DATE: _____

THE BOEING COMPANY



BY: _____
Eric R. Swanson
BCA Contracts Manager
The Boeing Company

DATE: 5/10/2022